"Patents, Innovation, and Productivity"

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Thank you for having me at your conference today. Speaking to a group of highly knowledgeable patent lawyers makes me feel a little like a foreigner coming to a new land. Like any foreigner, I can tell you a little about the land I come from, give you some descriptions of some of the other places I have visited on my way here and offer some observations about your land. My hope is that this slightly different perspective might enable you to see some perspectives and links that you might otherwise have missed in your own land.

Specifically, first I will talk in very broad terms about productivity, inequality, and what they mean for household incomes. Then I will talk about several other areas of innovation and some of the links between them and patents. Finally, I will talk about patents specifically—and highlight the steps the Administration has taken and is still working on to advance the goal of innovation, not litigation.

Productivity, Inequality, and Household Incomes

For an advanced industrial economy such as the Unites States, innovation is necessarily the wellspring of economic growth—catching up to the productivity frontier is not an option when you are already there.

Ultimately, our well being, at least in a material sense, depends on the productivity of the economy and how the gains that result from that productivity are shared. Productivity, in turn, depends on the amount of capital, the quality of labor and—most importantly—how we combine capital and labor together to produce more output, a concept called Total Factor Productivity or TFP. When TFP increases, a country experiences higher levels of output even when both the returns to and the amount used of capital and labor remain constant.

TFP is responsible, on average, for more than half of productivity growth, with capital deepening and improvements in the quality of labor constituting the remainder. But the growth of TFP has changed dramatically across time and this, in turn, has had profound implications for income growth. We can think of three postwar periods for TFP growth, albeit these divisions are somewhat arbitrary but they tell an important story and capture an important truth. From 1948 to 1973 a wave of innovation and public investment, much of it driven by pent up innovations that went in on the military side in World War II were commercialized, like the jet engine, but also public investment like the interstate highway system and substantial investment in R&D helped

drive TFP up at a 1.9 percent annual rate. As these innovations petered out, a wave of dislocations associated with the collapse of the Bretton Woods system and the oil shocks of the 1970s contributed to the slowing of TFP growth to a 0.4 percent annual rate from 1973 to 1995. Then from 1995 to the present we have seen a partial rebound of TFP growth with the new economy, including the internet and mobile computing, which has help fuel 1.1 percent annual TFP growth – nearly triple the rate from 1973 to 1995, but still below the immediate postwar years.

These differences may sound small but over time they cumulate to very large differences in national output and thus to living standards as well. To put this in perspective, if the 1.9 percent TFP growth from 1948 to 1973 had continued to the present, incomes in 2013 would have been 58 percent higher—or an additional $30,000 for a typical household.

Technology optimists, like Erik Brynjolfsson and Andrew McAfee have pointed to current innovations to argue that we will be able to further increase productivity growth. It is true that technology is creating new industries and transforming old ones throughout the economy. Some of the most visible changes are occurring in the information and communications technology sector, where a combination of smaller, more powerful computing and communications devices as well as improvements in wired and wireless broadband connectivity have unleashed a new wave of development in applications—something that is leading rapidly to an "internet of things," where devices can connect to each other through the cloud.

Many scientists also say that we are on the cusp of a revolution in life sciences. The first complete human genome was sequenced in 2003 at a cost of roughly $3 billion, but today it can be done much faster and for as little as $1,000 per person, a development that could help usher in an era in which personalized medicine meets evidence-based medicine, transforming health care. Transformations similar to those that we see in advanced materials and renewable energy generation. Progress in the domain of nanotechnology holds tremendous potential at the intersection of both of these areas, potentially helping energy efficiency with new materials.

Some economists have been much more skeptical about the happy story that I just went through. John Fernald of the San Francisco Fed argues that productivity growth started to slow even prior to the Great Recession as, in his argument, the economy exhausted the biggest gains from the use of information technology. More famously, Robert Gordon at Northwestern has questioned whether we are running out of transformative new ideas, arguing that all of the new "gadgets" we now use are not particularly transformative compared to what he terms as the historical advances such as the arrival of indoor plumbing. The disappointing productivity growth numbers in the last several years have fueled the concerns that Fernald and Gordon have put forward.

In my own opinion, while the most extreme techno-optimistic scenarios may not materialize, I do not believe there is cause for substantial pessimism either—there is no reason we cannot continue to enjoy the generally strong productivity growth we have had for the last twenty years and maybe build on that as well. Personally, I would never place too much weight on just a few years of productivity data from 2010 to 2014 and extrapolate out to the future when a lot of what was going on in those years was very special and specific to the hangover following the Great Recession and the lack of capital investment that resulted from a broken banking system and

capital overhang. Moreover, there are serious measurement issues when we fail to capture the increased variety and quality of products; many of the most exciting online products are free, so you may actually miss them in your productivity data.

Finally, it is important to recognize that it often takes time for technical breakthroughs to appear in the productivity statistics because current technologies are often deeply intertwined with how we use physical, human and organizational capital. For example, the economic historian Paul David has described how electrification led to the radical redesign of many factories and industrial work processes, which shifted from being vertical and urban to horizontal and exurban. Such a process does not happen overnight. It seems reasonable then to expect that similar processes of industrial reorganization, resulting from revolutions in technologies such as mobile computing, robotics and genomic sequencing, will lead to a lag between the technology's introduction and full realization of its growth-inducing potential.

This last point about the diffusion of new technology into the broader economy and its delayed productivity impact, holds some important implications for our thinking about patent policy. In particular, Paul David's work reminds us that each technological breakthrough is only the beginning of a long process of translating invention into practical benefits for all. It is clearly important that we provide incentives and rewards to inventors, for without that first step there would be nothing to follow. However, it is equally important that we design a patent system that provides incentives for follow-on invention and investments in commercialization, by tailoring the scope of patent rights and encouraging markets for technology that produce an appropriate balance between the rewards to risk-takers at all stages of the innovation process.

The other factor that matters for middle class incomes, in addition to the rate of productivity growth, is how the benefits of that growth are shared. Let me briefly discuss this issue. At the same time that productivity growth started to slow in the 1970s, the gains from this growth started to be shared less equally. The share of income going to bottom 90 percent of households fell from 68 percent in 1973 to 52 percent in 2013. The combination of productivity slowing and inequality widening has had a huge impact on incomes. Incomes from 1948 to 1973 had gone up at 2.9 percent a year, a rate that would double incomes every 24 years, or once a generation. . At that rate they doubled every 24 years. Then income growth slowed in the next period to somewhere between 0 and ½ percent per year, depending on how you measure it, meaning that it would take over a century for incomes to double.

One of the reasons for the increase in inequality was the fact that technological developments over this period favored workers with skills—and the increase in the supply of skilled workers actually slowed. Other factors also played a role, including institutional changes such as declines in unionization and the purchasing power of the minimum wage, the expansion of globalization, and changes in norms about compensation.

Innovation and its role in inequality is particularly important. The lesson is of course not that we want less innovation. In fact innovation itself does not necessarily create inequality—America's period of most rapid productivity growth, from 1948 to 1973, was also a period when inequality actually narrowed somewhat. In fact, to the degree that innovations complement less skilled labor they can help to raise wages for typical workers. New technologies can level the playing

field in other ways, for example the President's ConnectEd initiative which has the goal of providing 99 percent of American school students with access to high-speed broadband by 2017.

In addition, the impact of innovation on inequality depends on what we are doing on the other side of the equation. If you are developing technologies that complement people with skills, that means that you need to be producing more people with skills and investing in human capital.

And finally, if you do all of those steps and you still see an increase in inequality, you at least have a larger pie which puts you in a better position to pursue progressive tax policies that ensure that everyone shares in the benefits of higher aggregate levels of growth.

Some Key Elements of the President's Innovation Strategy

With that overall macroeconomic context, I now want to dive into some of the policy areas that we are particularly focused on in pursuing new levels of innovation. Patents are a central element of our innovation policy. But they are just part of a broader strategy. For example, while innovation is broadly distributed throughout the economy, companies in the manufacturing sector account for 70 to 80 percent of U.S. patents. Of course manufactured goods such as computers and communications equipment are used as inputs to those other sectors, so that patented technology contributes to rising productivity throughout the economy. My point is simply that we should think about patent policy as operating within this larger context. So in this part of the talk I will provide some of the parts of that larger context.

Direct R&D Support

The federal government has a long tradition of support for research and development, based on the idea that R&D has the essential feature of what economists call a public good—it produces substantial benefits that are not captured by any single economic agent and can often be enjoyed by other agents at no cost.

Basic, fundamental research is critical to creating a foundation for innovation as well as simply better understanding the world around us. This is the type of research with the largest externalities and thus the least basis for private financing. The bulk of the government's research funding goes for such activities.

But even smaller amounts invested in applied research can have substantial payoffs. For example, the Advanced Manufacturing Partnership has led to three years' worth of executive actions that have matched billions of dollars of money from federal agencies such as NASA with private industry and academic researchers who are involved in developing emerging manufacturing technologies.

One notable policy instrument we have tried to focus on in the Obama Administration is the use of competitions and prizes. By September 2012, the Administration had organized more than 200 innovation competitions. Prizes have played a role in advancing autonomous vehicles, producing new technologies for cleaning oil spills and developing mathematical models that can help

improve response rates for the Census. Prizes are an alternative to direct funding through grants. Like patents, they aim to draw private resources into the search for a solution and they can complement the patent system by providing incentives in areas such as mathematical algorithm development that fall outside the boundaries of patentable subject matter.

Spectrum

The second is spectrum. The spectrum used for mobile broadband and other broadcast technologies is also critical for innovation for the types of innovations I've been talking about. Between 2009 and 2012, annual investment in U.S. wireless networks grew more than 40 percent, from $21 billion to $30 billion. This investment fuels a vibrant ecosystem that is critical to our productivity growth. However, it also raises the possibility of what former FCC Chairman Julius Genachowski has called the "spectrum crunch."

The additional bandwidth to meet the growing demands of mobile broadband will come from a variety of sources including the repurposing of spectrum used by federal agencies and private broadcasters, improved receiver design, the adoption of new technologies that allow more users to share a given frequency, and the use of unlicensed spectrum over particular small areas around a device at specific points in time.

How does spectrum policy relate to patents? To take one example, consider the role of interoperability standards in the mobile ecosystem and the recent disputes over Standards Essential Patents, particularly in the context of litigation among smartphone manufacturers. A central question in these disputes is whether injunctive relief or an exclusion order is appropriate if a patent holder has made a voluntary commitment to license their Standards Essential Patent on reasonable terms and conditions.

In January 2013, the Department of Justice and United States Patent and Trademark Office issued a joint Policy Statement on remedies for Standards Essential Patents subject to voluntary licensing commitments. In August of that year, the U.S. Trade Representative disapproved an exclusion order issued against Apple for importing products that infringe this type of patent. While these actions are often discussed in narrow terms that focus on the patent system and the interests of specific parties, in my view it is important to view them in the context of a broader set of innovation policies—including spectrum policy—that aim to promote economic growth by balancing the reward to inventors and the incentives to invest in technology deployment and commercialization.

Energy

The third area is energy. Innovation has also played a critical role in the energy revolution we have been enjoying, with increased production of oil, natural gas, and renewables and reductions in the use of energy throughout our economy. Overall these developments are helping to boost jobs, growth, and our macroeconomic stability while at the same time reducing carbon emissions.

Innovation has played a role in the ongoing energy revolution, with new technology—much of it patented—expanding our access to natural gas and renewable resources that allow us to produce cleaner and more efficient electricity. In this sector, regulations that cause private parties to internalize externalities, such as fuel economy standards for vehicles or emissions rules for power plants, provide an inducement for innovation and patents can help support the market for diffusing new technological solutions as they emerge.

Human Capital

Finally in this area, human capital is critical, not just to the overall level of productivity growth, but to how that productivity growth is shared. Central to that is proficiency in Science, Technology, Engineering, and Math, the so-called STEM fields.

Also important is an immigration system that is conducive to attracting skilled workers to the United States and making sure that the people that already are here in enormously uncertain conditions can have greater certainty that they can make investments in human capital as well. In fact when the Congressional Budget Office to a look at the Senate-passed immigration reform bill, they said it would add 3.3 percent to our economic growth after a decade and quite striking, they said that more than one-fifth of the addition to that growth is because it would result in higher Total Factor Productivity Growth. So it is not just bringing extra workers into the country, it is bringing ideas and knowledge into the economy. In fact some of the main evidence that the CBO cited is the fact that foreign born are roughly 10 percent of the U.S. working age population, they count for 20 percent of the U.S. science and engineering workforce, nearly 50 percent of those with doctorates and they patent at a much higher rate on average than native born Americans. In fact native born Americans' rate of patent increases when they're in proximity to more innovators.

Patent Policy Goals and Developments

Finally for the third, broad part of our discussion today, I wanted to discuss our patent reform agenda more specifically. I should say at the outset that one important part of that agenda is having a confirmed head to the USPTO and we are really excited to see Michelle Lee, the current deputy director, has been nominated for that role and we look forward to seeing her confirmed as quickly as possible.

President Obama has taken a personal interest in patent policy. It is an issue he's brought up with us quite a lot between his first days in office and now. As I said, he signed the America Invents Act (AIA) in 2011 and then continued to hear concerns around patent assertion entities (PAEs) that led him, in a Google Hangout in February 2013, to call for "some additional consensus on smarter patent laws." Later that year the Administration announced a set of executive actions and legislative priorities specifically aimed at reducing the economic damage caused by those who abuse the current system. The House passed a bill advancing many of these objectives and we continue to believe that Congress should act in this area. At the same time, during its last term, the Supreme Court granted certiorari on six patent-related cases and issued several major decisions that are broadly aligned with President's reform agenda.

The Economics of Patent Reform

The traditional economics behind patents is well known. They are designed to balance a trade-off between the incentives for innovation conferred by granting temporary monopoly power against the costs to consumers in the form of higher prices from the exercise of that power. Traditionally you work to balance these innovation and consumer price effects in answering questions like the length of patents. The lesson of this line of thinking is that a strong intellectual property regime is critical to innovation and growth, but that the relationship between the strength of the system and social welfare is not monotonic.

But building on my earlier discussion, increasingly we are seeing a new type of tradeoff within innovation itself. Specifically, while protection gives you more incentive for the first innovation, it can interfere with the subsequent innovations that build on it.

And even more recently we are seeing the emergence of an area of intellectual property where there is pretty much no trade-off at all and instead of balancing innovation against prices we risk getting the worst of both worlds. I am speaking particularly about abusive PAEs. These entities brought one-fifth of all patent lawsuits over the 2007-11 period covering about one-third of all defendants. These PAEs purchase rights to patents belonging to other firms and then assert them against firms or individuals who are using the patented technology. Some of this activity is valuable: incentives to invent are stronger if inventors know they can later sell their patent to, or merely engage the services of, a PAE that can assert it more effectively than they could do themselves. Also, in some cases, it may be efficient for PAEs to act as intermediaries by obtaining the rights to patents held by disparate inventors in order to decrease the transaction cost of negotiating licenses. However, many industry observers believe that PAEs often do not assert patents in good faith, but rather assert them simply in order to extract nuisance payments from firms looking to avoid costly and risky litigation. In some cases, these patents are valid but of low value, meaning that absent the high cost of litigation they would only command very low licensing fees. In other cases, the patents are invalid (or not infringed) and absent the high litigation costs they would not command any license fees at all.

These issues motivate our three goals for patent policy: (i) improving patent quality to reduce the harms caused by vague and overly broad claims; (ii) ensuring that all parties bear their fair share of the costs and risks of litigation; and (iii) increasing transparency in the patent system.

Increasing Patent Quality

Deputy Director Lee has spoken about the importance of patent quality on numerous occasions. And she has rightly emphasized that quality has *always* been a priority for the USPTO. Greater quality can bring greater certainty to the market for technology, reduce needless litigation and ultimately fuel innovation. This is why an important provision of the America Invents Act was the USPTO's expanded fee-setting authority, which allows the office to operate on a firm financial footing and maintain its efforts on providing high quality examinations. Another key step to improving patent quality that the USPTO has taken is to implement the several new forms

of administrative review, including post-grant review, of patents created by the AIA, which in many cases offer faster and less expensive alternatives to litigation in Federal courts.

Some of the USPTOs other recent quality initiatives include carrying out several executive actions to recruit innovators from industry to instruct patent examiners on the state of the art and enhance the clarity of patent claims and enhancing the ability of the USPTO to "crowdsource" the search for prior art of a patent, leveraging significant interest in the technical community to improve patent quality.

In addition to what we have been doing, last term, the Supreme Court also decided a pair of cases that should contribute to improvements in patent quality. In *CLS Bank v. Alice*, the Court decided to limit the patentability of abstract ideas that are implemented by a computer. And in *Nautilus v. Biosig*—another unanimous decision—the Court raised the bar for vague patents by requiring a greater claim of "definiteness." These two decisions support the President's policy goals and the USPTO is now implementing new guidance for issuing and reviewing patents in light of these decisions.

Equitable Litigation

A second area is equitable litigation.

Since the President's June 2013 policy priorities called attention to this issue as a legislative priority, at least sixteen U.S. States have passed legislation addressing vague or otherwise unfair demand letters and similar legislation is pending in thirteen others. These laws will help knowledgeable victims resist unfair practices. This spring the USPTO also launched an online portal that provides plain-English explanations of the patent system, the rights of those accused of infringement and how to get help.

Another tactic employed by the more unscrupulous PAEs is to sue a large number of defendants and increase the costs of defense through aggressive demands for discovery. These tactics produce large asymmetries in the cost and risks of litigation, thereby encouraging defendants to settle rather than test the strength of a plaintiff's case in court.

In February 2014, the Supreme Court decided a pair of cases, *Highmark v. Allcare* and *Octane Fitness v. Icon*, that make it easier for courts to award fees to prevailing parties. These decisions place some of the unevenly distributed cost and risk of patent litigation back on to plaintiffs who use abusive tactics. Recent cases have awarded fees against abusive litigants, though it remains too early to know their overall impact, or whether assertion entities will find a way to adapt their business model to the new environment.

Transparency

A third priority for the Administration is to promote transparency of patent ownership. The goal here is to combat the litigation tactic of hiding behind shell companies and provide the market with greater clarity regarding the ultimate owner of a given patent. Improving ownership

transparency can reduce uncertainty in bilateral negotiations and help companies more-accurately account for risk.

Last year, the USPTO issued a Notice of Proposed Rulemaking to require patent applicants to provide additional ownership information and Congress considered legislation addressing transparency of patent ownership information.

While advocating for a more comprehensive transparency provision in legislation, the USPTO has moved forward on the transparency issue through long-term investments in IT, including improvements to the online search functionality for voluntarily-provided patent assignment information.

Looking Forward

While much progress has been made on patents, we know more can be done still and we look forward to working with Congress on a set of bipartisan reforms to further strengthen our patent system so that our nation's innovators can focus on innovation, not litigation.

Many of the issues that the President's proposed reforms address are problems that mainly affect firms in the information and communications technology sector. This reflects a fact that patents work differently for different kinds of technology.

The product life cycle in parts of the software industry can be measured in months, while a new pharmaceutical product may take more than 10 years to go from discovery through clinical testing. Moreover, a pharmaceutical product might incorporate a handful of patents, whereas many information technology products have hundreds of components, each of which include scores of patented technologies owned by many different firms.

To work well in such varied technological and commercial environments, our patent system must be flexible. With that goal in mind, I would like to conclude by highlighting two areas where additional policy analysis and eventually reform, might help resolve some of the tension that exists among different users of the current patent system.

The first area is damages. Put simply, courts struggle to determine a reasonable royalty when economic value or profit must be apportioned among large numbers of patents and component technologies. The *Georgia Pacific* factors suggest some useful types of evidence and ways of thinking about the problem, but provide little in the way of an overarching framework, or an actual methodology. The resulting uncertainty leads to divergent expectations about patent value that encourage litigation; allows experts to produce valuations that differ by orders of magnitude; and contributes to headline-grabbing jury awards that are often reduced on appeal. There are no simple solutions to this problem—the underlying economic issues are difficult ones. However greater clarity in terms of how courts will address damages in complex product cases could do much to reduce rapidly growing litigation rates and allow for a patent system that is tailored to different industry environments in a principled way.

The second area is promoting the market for technology. Firms in the information technology sector have developed a variety of creative contractual solutions to the unique issues created by complex products that incorporate many patents. These tools include broad cross-license agreements, voluntary agreements to license on reasonable terms, commitments not to assert, patent pools, and even open-source license agreements. These agreements are complex and sometimes costly to create, but can dramatically lower long-term transaction costs in licensing. Policy makers should consider ways to support these agreements where they work well, for example by considering recordation of commitments, taking steps to ensure that they survive bankruptcy proceedings, or by providing appropriate guidance, such as the Department of Justice and Federal Trade Commission's Antitrust Guidelines for the Licensing of Intellectual Property, which are now approaching their 20th anniversary.

Conclusion

In conclusion, I hope I have shed some light on how an economist thinks about the big questions of innovation, productivity, and economic growth. And in discussing these issues, I hope I have made clear how important the patent system is to that process and how it fits into a broader set of innovation policies.

The President feels strongly about these issues and will continue work toward a broad consensus around smart patent policies that reward American innovators and promote economic growth and job creation.

I would be happy to take a few questions. Thank you.